A Simple Account of the Behavior of Long-Term Interest Rates

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A SIMPLE ACCOUNT OF THE BEHAVIOR OF LONG-TERM INTEREST RATES

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ABSTRACT

Recent empirical research on the term structure of interest rates has shown that the long-term interest rate is well described by a distributed lag on short-term interest rates, but does not conform to the expectations theory of the term structure. It has been suggested that the long rate "overreacts" to the short rate. This paper presents a unified taxonomy of risk premia, or deviations from the expectations theory. This enables the hypothesis of overreaction to be formally stated. It is shown that, if anything, the long rate has underreacted to the short rate. However, the independent movement of the long rate is primarily responsible for the failure of the expectations theory.

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I. Introduction.

To a first approximation, long-term interest rates behave like short-term interest rates. For example, the yields on twenty year Treasury bonds and on one month Treasury bills tend to peak and to bottom out together. Thus people often speak of "the level of interest rates" without specifying maturity.

The spread between long rates and short rates tends to be unusually small or even negative when short rates are high relative to the experience of the last few years. Modigliani and Sutch showed that the relation between long and short rates can be well described by expressing the long rate as a five-year distributed lag of short rates, with the coefficients summing to about one and with substantial weight on the current short rate. Recent experience upholds this characterization except that the distributed lag has become shorter (Ando and Kennickell). Equivalently, the spread between long and short rates is well explained by current and lagged short rates, with approximately equal and opposite coefficients on the current rate and the sum of lagged rates. (See table 1, row 1).

This moving average relation could be consistent with the simple expectations theory of the term structure, if investors look to the recent past to form expectations about future interest rates. Whether such expectations are rational depends on the time series properties of short-term interest rates. Depending on the policy regime and its implications for the movements of short rates, the observed distributed lag might correspond to a rational expectations theory of the term structure, or a theory of overreaction or underreaction of long rates to short rates, relative to the predictions of the rational expectations model. Experimental psychologists, such as Tversky and Kahneman, claim to have shown that people tend to overreact in their expectations to evidence which seems superficially to be relevant, even after experience should have convinced them otherwise. This suggests that there might be policy regimes where the long rate overreacts to temporary movements in short rates. Of course, any such "overreaction" might also be reconciled with the theory of finance if certain covariances change with the short rate.

A look at the data suggests an abrupt policy shift starting with the Fed's new operating procedures in October 1979. We concentrate here on the policy regime which prevailed between the 1951 Treasury accord and 1979. Modigliani and Shiller claimed that for the early part of the period the observed distributed lag was approximately consistent with the time series properties of the short rate given a simple expectations model, and Sargent was unable to reject this hypothesis with a likelihood ratio test in a vector autoregression. However, more recent work has cast doubt on the notion that the simple rational expectations model of the term structure is adequate even as a first approximation to the behavior of interest rates. It was shown by Shiller that when long-term interest rates are unusually high relative to short rates they then tend to fall rather than rise as predicted by the expectations theory. Shiller, Campbell and Schoenholtz showed that when six-month bill rates are higher than three-month bill rates there is no tendency for the three-month bill rate to rise subsequently. Hansen and Sargent were able to reject the rational expectations theory at the 0.5% level with a likelihood ratio test on postwar U.S. data when an additional restriction involving the current long-term interest rate was added to Sargent's earlier formulation.

These results might be summarized as finding that the behavior of long-term interest rates is dominated by a "risk premium" which is so variable as to swamp out expectations in determining the slope of the term structure. The phrase "risk premium" has been defined in various ways in the term structure literature. We turn next to a discussion which will clarify the relations among these definitions. This enables us to state more formally the hypotheses that long rates overreact or underreact to short rates, and it provides a framework in which we characterize interest rate behavior.

II. "Well-Tempered" Definitions of Risk Premia.

We make use here of approximations to holding-period yields and forward rates which are obtained by linearizing the exact expressions around the coupon rate on a long-term bond. These approximations were developed by Shiller, Campbell and Schoenholtz who also investigated their accuracy. Such preliminary linearization is essential if risk premia are to be defined in a coherent way, that is so that Jensen's Inequality problems do not make their interrelationships extremely complicated. The analogy with the reconciliation of different keys in music leads us to call our system a "well-tempered" one.

We chose our definitions to facilitate comparison with bond yields as commonly quoted. Bonds issued with less than a year to maturity commonly carry no coupons, but longer term bonds generally pay coupons which bring their sale price near par. It is natural then to define the five year ahead ten year forward rate, for example, as the yield on a ten year coupon bond to be purchased at par five years hence. Such an asset can be constructed today as a portfolio of bonds with maturities up to fifteen years. Similarly, the five year holding return on a fifteen year bond is the yield to maturity on buying the fifteen year bond, receiving its coupons, and selling it five years hence (when it is a ten year bond). The fifteen year holding yield on a five year bond is the yield to maturity on an investment in three consecutive five year coupon bonds, reinvesting principal (i.e. rolling over the five year bonds) but receiving coupons.

The linear approximation to the j-period holding yield on an i-period bond is:

$$(1)\quad h_t^{(i,j)} = \frac{D_i R_t^{(i)} - (D_i - D_j) R_{t+j}^{(i-j)}}{D_j} \qquad 0<j\le i$$

$$(2)\quad h'^{(i,j)}_t = (1/D_j)\Big[\sum_{k=0}^{(j-i)/i} (D_{ki+i} - D_{ki})\, R_{t+ki}^{(i)}\Big] \qquad 0<i\le j,\ j/i \text{ integer}$$

The linear approximation to the n-period ahead m-period forward rate is:

$$(3)\quad f_t^{(n,m)} = \frac{D_{m+n} R_t^{(m+n)} - D_n R_t^{(n)}}{D_{m+n} - D_n} \qquad 0<m,\ 0\le n$$

$R_t^{(i)}$ = yield to maturity on an i-period bond

$D_i = (1-g^i)/(1-g)$, $g=1/(1+\bar{R})$, $\bar{R}$ = coupon rate

D_i is the "duration" of an i-period bond selling at par with coupon $\bar{R}$, as defined originally by Macaulay. Duration is intended as a better measure than maturity of how "long" a bond is. It takes account of the fact that bonds with coupons derive much of their value from payments which are made earlier than maturity. Thus for bonds with coupons, $D_0 = 0$, $D_{i+1}-D_i=g^i$, so $D_i<i$ for $i>1$. For pure discount bonds, $\bar{R}=0$ and duration and maturity are the same.

The simple expectations theory of the term structure, with no allowance for risk, equates $E_t h_t^{(i,j)}$ or $E_t h'^{(i,j)}_t$ with $R_t^{(j)}$, and $f_t^{(n,m)}$ with $E_t R_{t+n}^{(m)}$. Risk premia are deviations from this theory, which can be written either as differences between expected holding returns and yields, or as differences between forward rates and expected spot rates. We denote the former as $\phi^{(i,j)}$ ($j \leq i$) or $\phi'^{(i,j)}$ ($j \geq i$), and the latter as $\psi^{(n,m)}$. Then we have the holding period risk premium:

$$(4) \quad \phi_t^{(i,j)} = E_t h_t^{(i,j)} - R_t^{(j)} \qquad j \leq i$$

the rolling risk premium:

$$(5) \quad \phi'^{(i,j)}_t = E_t h'^{(i,j)}_t - R_t^{(j)} \qquad j \geq i$$

and the forward rate risk premium:

$$(6) \quad \psi_t^{(n,m)} = f_t^{(n,m)} - E_t R_{t+n}^{(m)}$$

ϕ, ϕ' and ψ all appear in the existing literature on the term structure. Our well-tempered formulation allows us to derive simple linear relationships among them. First, we can substitute (1) and (3) into (4) and (6) to show that

$$(7) \quad \phi_t^{(i,j)} = \frac{D_i - D_j}{D_j} \psi_t^{(j,i-j)} \qquad \psi_t^{(n,m)} = \frac{D_n}{D_{m+n} - D_n} \phi_t^{(m+n,n)}$$

Secondly, we can rearrange equation (3) so that it expresses the j-period bond rate as a weighted average of forward rates of maturity i, with weights equal to those in equation (2). It is immediate that

$$(8) \qquad \phi'^{(i,j)}_t = -(1/D_j)\left[\sum_{k=0}^{(j-i)/i} (D_{ki+i} - D_{ki})\,\psi^{(ki,i)}_t\right] \qquad 0<i\leq j$$

Finally, we can rearrange equation (1) so that it expresses the j-period bond rate at time t as a function of the i-period holding return on a j-period bond and the (j-i)-period bond rate at time t+i. By recursive substitution, we obtain the following expression:

$$(9) \qquad \phi'^{(i,j)}_t = (-1/D_j)\left[\sum_{k=0}^{(j-i)/i} (D_{ki+i} - D_{ki})E_t\,\phi^{(j-ki,i)}_{t+ki}\right]$$

A natural interpretation of the notion that long rates overreact to short rates is that long bonds are a "good investment" when the short rate is high. In other words, the returns on long bonds over some holding period tend to be higher than those predicted by the expectations theory when the short rate is high: the holding period or rolling risk premium is positively correlated with the short rate.[1] In

[1] Mankiw and Summers interpreted overreaction as the hypothesis that the long rate behaves according to the expectations model for a bond of shorter duration. This definition is consistent with ours, in that if long rates overreact in Mankiw and Summers' sense, and if the time series process for short rates is stationary, then the holding period risk premium is positively related to the short rate. The reverse is not necessarily true, however. We note that incorrect duration, whether too short or too long, could never explain the observation that the slope of the term structure gives wrong signals about the future path of interest rates.

the next section we examine the relation between the one month excess holding return on a twenty year bond, and the one month Treasury bill rate. We do not calculate the twenty year excess return on a twenty year bond, which includes the rolling risk premium, since we have only just over twenty years of data. However, we study the rolling risk premium indirectly by conducting an ARIMA analysis of the one month bill rate.

III. The Behavior of Risk Premia.

We can estimate ϕ_t by regressing the excess return $h_t^{(i,j)} - R_t^{(j)}$ on variables in the information set at t. The excess return is just (D_i/D_j-1) times the forward-spot rate difference $f_t^{(j,i-j)} - R_{t+j}^{(i-j)}$, so equivalent results are obtained with this dependent variable.

Kessel ran regressions of forward-spot rate differences at the short end of the term structure on the short interest rate, and concluded that the forward rate premium was positively related to the short yield. Such a correlation could be taken to mean that long interest rates overreact to short rates. However, our work with more recent data shows that the effect of the short rate is, if anything negative (table 1, row 2). But the short rate has very little explanatory power; it is rather the spread between long and short rates (table 1, row 3) which explains excess holding returns. This is a reflection of the perverse behavior of the slope of the term structure in predicting future interest rates.[2]

There has been an uptrend in interest rates since Kessel's sample. This suggests an alternative overreaction or underreaction hypothesis that risk premia may be explained in terms of the difference between the short rate and a moving average or distributed lag of short rates. In fact, our results so far would seem to suggest just this, for by row 1 of table 1 the long-short spread which explains excess returns is itself well described as a distributed lag on short

[2] We note here the curious fact that excess returns of common stock over short debt also bear a significant positive relation to the long-short spread (Campbell). This observation suggests that risk premia on different assets move together.

rates. The coefficients lead us to expect that the risk premium is high when the short rate is low relative to recent experience. Nevertheless, when the excess return is regressed directly on current and lagged short rates (table 1 row 4), the point estimates are statistically insignificant. This evidence is not inconsistent with rational forecasting in the 1955-79 period. We note however that when the sample is extended to the end of 1982 the coefficient on the current short rate becomes negative and significant at the 9% level, while the sum of the lag coefficients is positive and significant at the 7% level. This could be taken to imply that long rates have underreacted to short rates.[3]

Another way to examine this issue is to conduct an ARIMA analysis of the behavior of short rates. Shiller's volatility analysis suggested that nonstationarity of interest rates might be necessary to justify the behavior of long rates; we assumed this conclusion and used monthly data over the period 1955-79 to estimate an ARIMA (1,1,1) process for the 1-month bill rate. This specification has the important advantage of being time consistent, that is independent of the measurement interval. It implies that the long-short spread under the rational expectations theory of the term structure should be a function of current and lagged short rates, with the influence of lagged short rates declining geometrically at a rate equal to the MA parameter, and with the sum of the coefficients on lagged short rates equal to the negative of the coefficient on the current short rate. We found that the likelihood function was very flat, but was maximized by

[3] We observe a similar underreaction in postwar British data (Shiller, data set 5).

the model $(1-0.950L)\Delta R_t = (1-0.975L)u_t$. With these parameter values the rational expectations model implies that the coefficients in table 1, row 1 should be -0.47 and +0.47 respectively, with a very slow decay within the distributed lag. The Modigliani-Sutch distributed lag is roughly consistent with this, but has a more highly negative coefficient on the current short rate. This suggests that the rolling risk premium tends to be high when the short rate is low relative to its recent history.

When the short rate and its distributed lag are included in a regression together with the long-short spread (row 5 of table 1), we find that both become significant, and the coefficient on the spread triples. The fitted values in this regression look something like a multiple of the residuals from row 1, suggesting that the significance of the current and lagged short rates is due to the regression's trying to purge the long-short spread of the component which is explained by current and lagged short rates. When the fitted value and residual from row 1 are included separately, only the residual is significant (table 1 row 6). It is also the residual which in the 1955-79 sample accounts for the violation, noted by Shiller, of variance restrictions on holding period yields. When the sample is extended to 1982, however, both the fitted value and the residual explain excess holding returns and violate the variance restrictions.

We see then that holding period and rolling risk premia have if anything been negatively related to short rates, suggesting that long rates if anything have underreacted to short rates. If long rates had been a distributed lag on short rates, with a somewhat larger coefficient on the current short rate and smaller coefficients on lagged short rates, then excess holding returns on long bonds would have been less predictable than they in fact were. But this sort of underreaction was not primarily responsible for the failure of the expectations theory of the term structure. The independent movement of the long rate also violated the restrictions of the theory. In the 1955-79 period, it was that smaller part of the spread between long and short rates which was not explained by current and lagged short rates that caused excess volatility in holding period yields and destroyed the predictive power of the term structure.

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TABLE 1

Row	Dependent Variable	Constant	Short Rate $R_t^{(1)}$	Sum of Lagged Short Rates	Spread $R_t^{(240)} - R^{(1)}$	Spread: Fit	Spread: Residual	R^2 (DW)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	$R_t^{(240)} - R_t^{(1)}$	1.217 (0.068)	-0.805 (0.039)	0.878 (0.042)	--	--	--	0.809 (0.147
2	$h_t^{(240,1)} - R_t^{(1)}$	-0.139 (3.648)	-0.479 (0.766)	--	--	--	--	0.001 (2.008)
3	$h_t^{(240,1)} - R_t^{(1)}$	-5.642 (2.267)	--	--	3.095 (1.519)	--	--	0.014 (2.008)
4	$h_t^{(240,1)} - R_t^{(1)}$	-2.864 (4.047)	0.234 (2.341)	-0.272 (2.500)	--	--	--	0.018 (2.039)
5	$h_t^{(240,1} - R_t^{(1)}$	-15.442 (5.785)	8.552 (3.605)	-9.351 (3.901)	10.336 (3.440)	--	--	0.048 (1.977)
6	$h_t^{(240,1)} - R_t^{(1)}$	-3.751 (2.392)	--	--	--	1.388 (1.676)	10.336 (3.451)	0.032 (1.951)

Notes: All equations were estimated with monthly data from 1955:1 to 1979:8. Standard errors appear in parentheses. In Rows 1, 4 and 5 a cubic polynomial distributed lag was estimated, extending from Lag 1 to Lag 60, with a zero end point constraint. In Row 6 the explanatory variables are the fitted value and residual from Row 1.

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Data Appendix

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TABLE A.1

Row	Dependent Variable	Constant	Short Rate $R_t^{(1)}$	Sum of Lagged Short Rates	Spread $R_t^{(240)} - R_t^{(1)}$	Spread: Fit	Spread: Residual	R^2 (DW)
1	$R_t^{(240)} - R_t^{(1)}$	0.896 (0.067)	-0.681 (0.027)	0.819 (0.031)	--	--	--	0.807 (0.263)
2	$h_t^{(240,1)} - R_t^{(1)}$	0.085 (4.605)	-0.509 (0.766)	--	--	--	--	0.001 (1.666)
3	$h_t^{(240,1)} - R_t^{(1)}$	-9.991 (3.143)	--	--	6.761 (1.924)	--	--	0.036 (1.728)
4	$h_t^{(240,1)} - R_t^{(1)}$	-5.132 (5.424)	-3.678 (2.157)	4.623 (2.519)	--	--	--	0.027 (1.749)
5	$h_t^{(240,1)} - R_t^{(1)}$	-12.956 (6.686)	2.273 (3.688)	-2.528 (4.390)	8.733 (4.400)	--	--	0.039 (1.708)
6	$h_t^{(240,1)} - R_t^{(1)}$	-9.472 (3.313)	--	--	--	6.290 (2.144)	8.733 (4.385)	0.036 (1.712)

Note: All equations were estimated with monthly data from 1955:1 to 1982:12. The long rate and short rate are as in the text.

TABLE A.2

Row	Dependent Variable	Constant	Short Rate r_t	Sum of Lagged Short Rates	Spread $R_t - r_t$	Spread: Fit	Spread: Residual	R^2 (DW)
1	$R_t - r_t$	-0.554 (0.244)	-0.680 (0.041)	0.974 (0.043)	--	--	--	0.975 (1.480)
2	$h_t - r_t$	11.506 (11.119)	-2.072 (1.640)	--	--	--	--	0.035 (1.750)
3	$h_t - r_t$	-9.335 (3.135)	--	--	6.564 (1.668)	--	--	0.260 (2.213)
4	$h_t - r_t$	-34.244 (16.692)	-0.230 (2.804)	4.898 (2.969)	--	--	--	0.292 (2.290)
5	$h_t = r_t$	-20.004 (16.610)	17.246 (7.295)	-20.140 (10.138)	25.698 (10.005)	--	--	0.392 (1.866)
6	$h_t - r_t$	-8.788 (3.060)	--	--	--	6.071 (1.642)	25.698 (10.228)	0.317 (1.900)

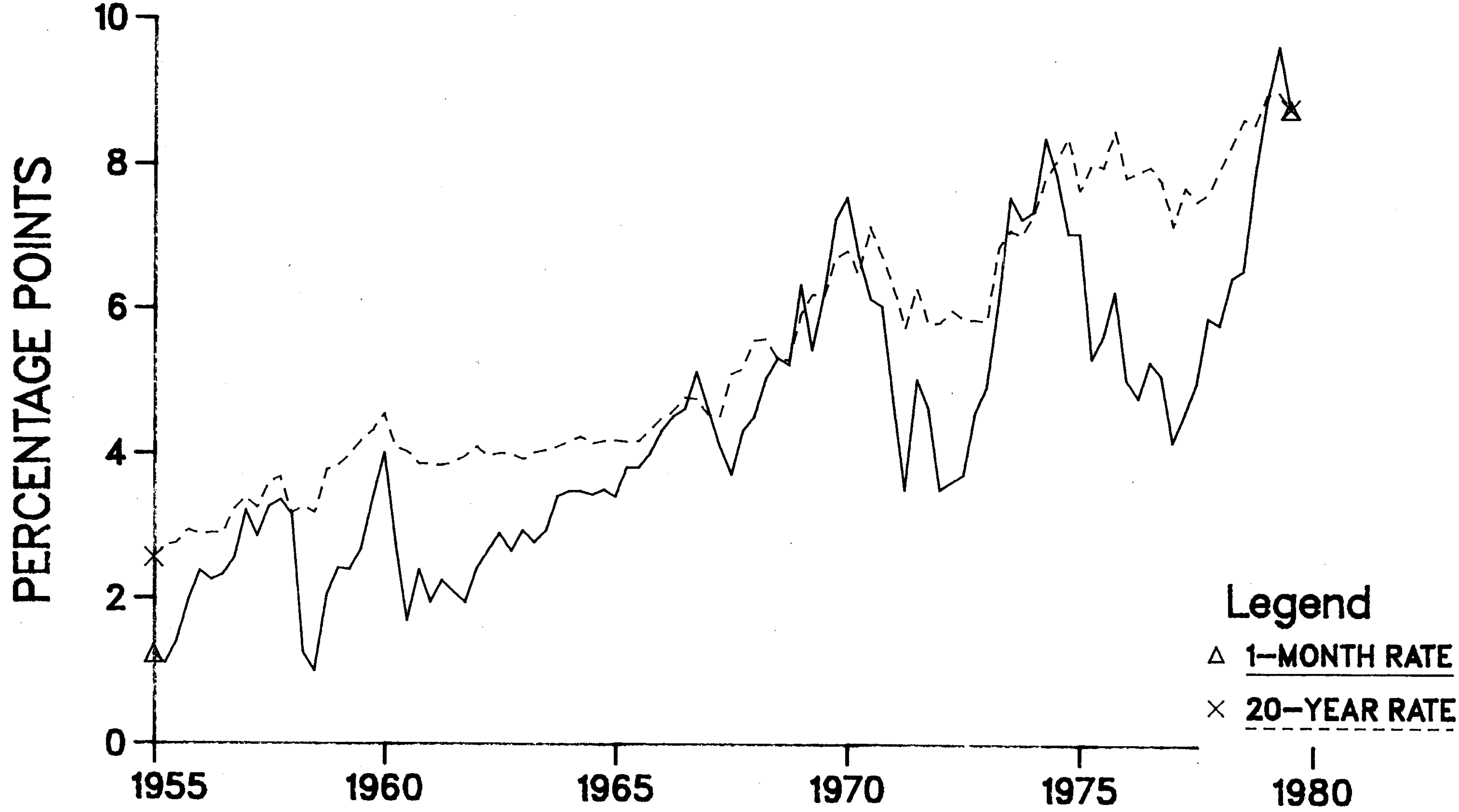
Notes: All equations were estimated with quarterly data from 1966:1 to 1977:2.
The long rate is the Federal Reserve recently offered AAA utility bond yield series, and the short rate is the 4 - 6 month prime commercial paper rate, as in Shiller (1979), Data Set #1.

TABLE A.3

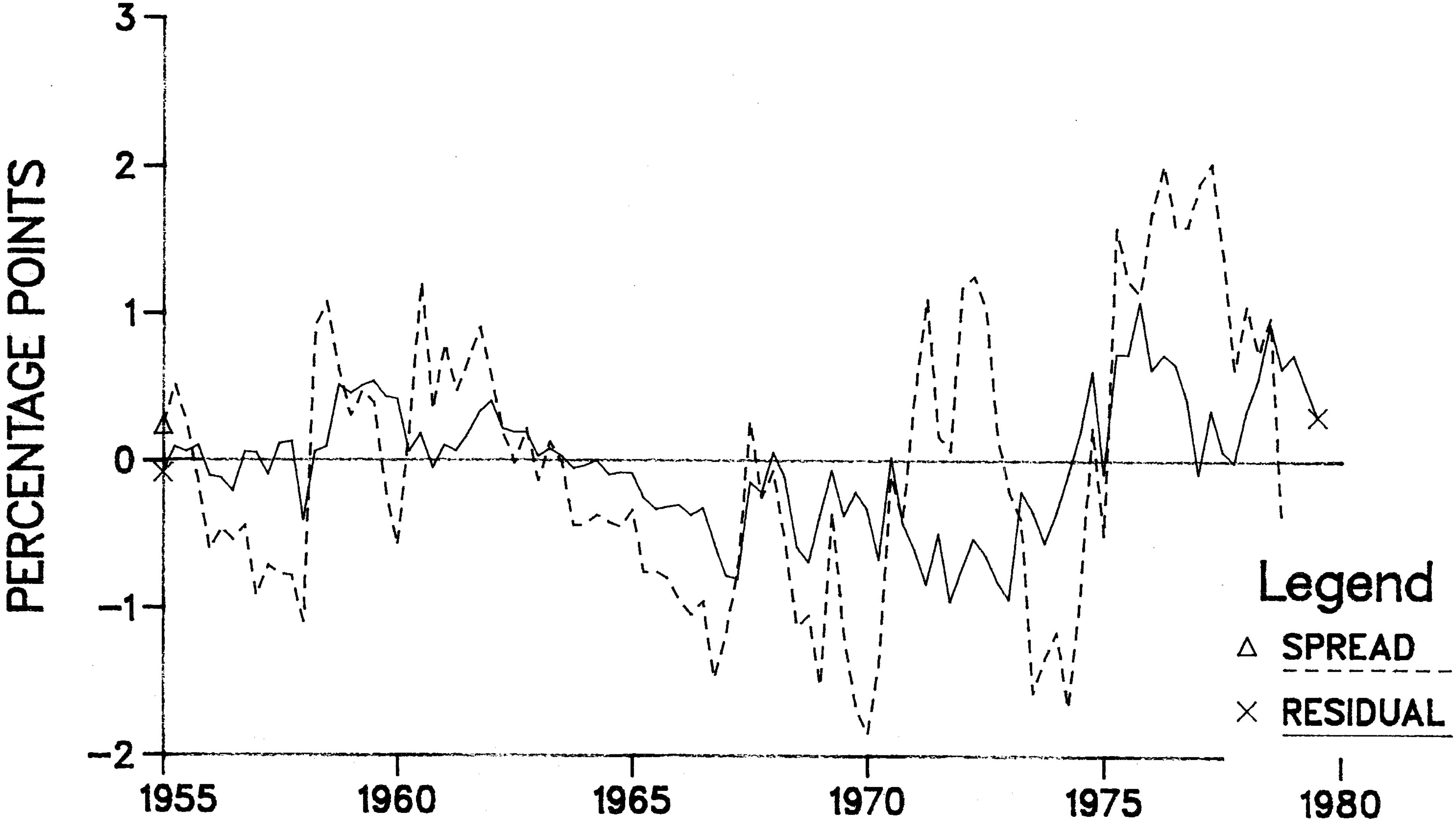
Row	Dependent Variable	Constant	Short Rate r_t	Sum of Lagged Short Rates	Spread $R_t - r_t$	Spread: Fit	Spread: Residual	R^2 (DW)
1	$R_t - r_t$	-1.733 (0.404)	-0.656 (0.060)	1.086 (0.090)	--	--	--	0.820 (0.683)
2	$h_t - r_t$	2.956 (14.176)	-0.644 (1.668)	--	--	--	--	0.002 (2.097)
3	$h_t - r_t$	-8.026 (3.890)	--	--	6.886 (2.095)	--	--	0.114 (2.270)
4	$h_t - r_t$	-27.433 (19.466)	-5.569 (2.892)	9.417 (4.325)	--	--	--	0.135 (2.599)
5	$h_t - r_t$	-17.674 (22.237)	-1.873 (4.982)	3.303 (7.981)	5.632 (6.175)	--	--	0.147 (2.440)
6	$h_t - r_t$	-11.906 (5.451)	--	--	--	8.885 (2.825)	5.632 (6.029)	0.146 (2.454)

Notes: All equations were estimated with quarterly data from 1961:1 to 1977:2. The long rate is the flat yield on 2=1/2% British Consols, and the short rate is the three-month local authorities temporary loan rate, as in Shiller [1979], Data Set #5.

Long and Short Rates, 1955–1979



Demeaned Spread and Residual



Data Sources

Salomon Brothers' Analytical Record of Yields and Yield Spreads gives point sampled Treasury bill rates and bond yields monthly from 1950:1 to the present.

The 20-year bond yield has been quoted at the first of each month since 1959:1, while the 1-month Treasury bill rate has been quoted at the first of the month since 1964:1. Before these dates, rates were quoted at the middle of each month.

First of month Treasury bill rates are available from the Treasury Bulletin.

The data used in the paper are aligned as follows:

Treasury bill rate:	1950:2 - 1958:12	middle of previous month (Salomon Brothers)
	1959:1 - 1963:12	first of month (Treasury)
	1964:1 - 1982:12	first of month (Salomon Brothers)
Treasury bond rate:	1950:2 - 1958:12	middle of previous month (Salomon Brothers)
	1959:1 - 1982:12	first of month (Salomon Brothers)

The transition from mid-month to first of month data does not distort the calculated holding period yield except in 1958:12.

Treasury bill rates were converted from discount basis to bond-equivalent yield basis using the formula

$$R^{(1)} = D/(1-D/1200),$$ where D is the discount rate.

Holding period yields were calculated using a duration for 20 year bonds of 152.5 months, or approximately 12½ years.

Sample 1950. 2.-1982.12.
Number of Observations = 395.

	R1 0	R240 0	EH2401 0
1950. 2.	1.1010	2.2600	-3.3847
1950. 3.	1.1411	2.2900	-6.4243
1950. 4.	1.1210	2.3400	-1.8103
1950. 5.	1.1711	2.3600	-1.8403
1950. 6.	1.6523	2.3800	-2.3014
1950. 7.	1.2513	2.4000	-3.3953
1950. 8.	1.1711	2.4300	1.2588
1950. 9.	1.1812	2.4300	1.2488
1950.10.	1.3215	2.4300	-.40593
1950.11.	1.3315	2.4400	1.1085
1950.12.	1.3615	2.4400	1.0784

1951. 1.	1.2212	2.4400	1.2187
1951. 2.	1.3916	2.4400	-.46632
1951. 3.	1.3615	2.4500	-12.543
1951. 4.	1.3415	2.5400	-13.948
1951. 5.	1.4518	2.6400	-7.8993
1951. 6.	1.6523	2.7000	19.223
1951. 7.	1.2513	2.5800	-12.303
1951. 8.	1.4016	2.6700	16.415
1951. 9.	1.5520	2.5700	-.49658
1951.10.	1.6523	2.5800	-9.6745
1951.11.	1.5420	2.6500	-3.4360
1951.12.	1.4016	2.6800	1.2783
1952. 1.	1.7225	2.6800	-9.6448
1952. 2.	1.4518	2.7500	4.3275
1952. 3.	1.3014	2.7300	1.4286
1952. 4.	1.5019	2.7300	5.7720
1952. 5.	1.5620	2.7000	19.313
1952. 6.	1.5721	2.5800	-3.5359
1952. 7.	1.5921	2.6100	-2.0115
1952. 8.	1.8529	2.6300	-2.2520
1952. 9.	1.5821	2.6500	1.0678
1952.10.	1.6523	2.6500	-15.663
1952.11.	1.6623	2.7600	10.186
1952.12.	1.4317	2.7000	-1.7608
1953. 1.	2.1137	2.7200	-9.9958
1953. 2.	2.0033	2.7900	.78670
1953. 3.	1.7626	2.7900	-11.089
1953. 4.	1.9532	2.8700	-5.1414
1953. 5.	2.2843	2.9100	-17.550
1953. 6.	1.6523	3.0300	-21.342
1953. 7.	1.2513	3.1800	30.706
1953. 8.	1.7024	2.9900	1.2876
1953. 9.	2.0435	2.9900	-.56813
1953.10.	1.7024	3.0000	24.017
1953.11.	1.3515	2.8500	-.16071E-01
1953.12.	1.2513	2.8600	13.726
1954. 1.	1.5019	2.7800	10.366
1954. 2.	1.1110	2.7200	13.726
1954. 3.	.95075	2.6400	10.777
1954. 4.	1.0008	2.5800	10.667
1954. 5.	1.0209	2.5200	-7.5885
1954. 6.	.75047	2.5800	3.3443
1954. 7.	.58028	2.5700	12.592
1954. 8.	.76048	2.5000	1.7395
1954. 9.	.92071	2.5000	1.5793
1954.10.	1.0309	2.5000	-4.5895
1954.11.	1.0008	2.5400	-4.5191
1954.12.	.65035	2.5800	3.4444
1955. 1.	1.2212	2.5700	-16.826
1955. 2.	1.4016	2.6900	-6.2847
1955. 3.	.95075	2.7400	3.3039
1955. 4.	1.1010	2.7300	-7.4587
1955. 5.	1.6021	2.7900	1.1879
1955. 6.	1.2012	2.7900	4.6179
1955. 7.	1.4016	2.7700	-12.263
1955. 8.	1.3215	2.8600	-9.0636
1955. 9.	1.6523	2.9300	-1.7514
1955.10.	1.9833	2.9500	13.084
1955.11.	2.1539	2.8700	-2.3130
1955.12.	2.1539	2.8900	.73603

1956. 1.	2.3847	2.8900	-1.0092
1956. 2.	2.4550	2.9000	15.591
1956. 3.	2.0736	2.8000	-15.934
1956. 4.	2.2542	2.9100	-29.636
1956. 5.	2.7563	3.1100	18.529
1956. 6.	2.4048	2.9300	14.217
1956. 7.	2.3245	2.9000	-13.056
1956. 8.	2.1539	2.9900	-23.398
1956. 9.	2.3044	3.1500	-12.786
1956.10.	2.5655	3.2400	9.7622
1956.11.	2.4550	3.1800	-14.421
1956.12.	2.5052	3.2800	-17.400
1957. 1.	3.2086	3.4000	15.338
1957. 2.	3.1080	3.3000	16.853
1957. 3.	2.7563	3.1900	-10.169
1957. 4.	2.8568	3.2600	-11.713
1957. 5.	3.1080	3.3400	-11.885
1957. 6.	2.6559	3.4200	-26.499
1957. 7.	3.2588	3.6000	6.3996
1957. 8.	2.9573	3.5600	-16.058
1957. 9.	3.0075	3.6700	-2.3666
1957.10.	3.3594	3.6900	-8.7571
1957.11.	3.4097	3.7500	47.293
1957.12.	2.7563	3.4400	40.064
1958. 1.	3.1583	3.1300	.21642E-01
1958. 2.	2.5554	3.1600	-14.521
1958. 3.	1.5520	3.2800	1.7280
1958. 4.	1.2513	3.2800	20.204
1958. 5.	1.1210	3.1600	3.5535
1958. 6.	.85060	3.1500	-3.7590
1958. 7.	1.0008	3.1900	-29.618
1958. 8.	.90068	3.4000	-41.424
1958. 9.	1.7526	3.6900	-11.694
1958.10.	2.0535	3.7800	7.7851
1958.11.	1.7024	3.7400	8.0959
1958.12.	1.7024	3.7000	-19.207
1959. 1.	2.4249	3.8400	-15.245
1959. 2.	2.4550	3.9500	15.127
1959. 3.	2.3546	3.8600	-18.185
1959. 4.	2.4048	3.9900	-15.076
1959. 5.	2.7463	4.1000	-.16082
1959. 6.	2.7563	4.1100	-10.763
1959. 7.	2.6860	4.1900	-.10705E-01
1959. 8.	2.4048	4.2000	-17.895
1959. 9.	3.3594	4.3300	.97070
1959.10.	3.4097	4.3300	17.581
1959.11.	3.1080	4.2200	-14.034
1959.12.	3.1080	4.3200	-33.624
1960. 1.	4.0134	4.5500	24.771
1960. 2.	3.5605	4.3900	8.4026
1960. 3.	3.8624	4.3400	38.343
1960. 4.	2.7563	4.0900	-28.959
1960. 5.	2.9573	4.2900	10.420
1960. 6.	2.5052	4.2300	32.017
1960. 7.	1.7024	4.0300	31.105
1960. 8.	1.7526	3.8400	-10.029
1960. 9.	1.8529	3.9200	11.155
1960.10.	2.4048	3.8600	-13.691
1960.11.	1.5520	3.9600	-3.6504
1960.12.	1.3515	4.0000	23.853

1961. 1.	1.9532	3.8600	-5.6663
1961. 2.	2.0033	3.9100	18.567
1961. 3.	2.1238	3.8000	-4.3821
1961. 4.	2.2542	3.8400	9.1589
1961. 5.	1.7024	3.7900	.57298
1961. 6.	2.2442	3.8000	-12.076
1961. 7.	2.1037	3.8900	-7.3012
1961. 8.	1.6021	3.9500	-11.284
1961. 9.	2.0234	4.0400	12.619
1961.10.	1.9532	3.9700	2.0168
1961.11.	1.9632	3.9700	-2.5372
1961.12.	2.1539	4.0000	-13.300
1962. 1.	2.4148	4.1000	-5.8877
1962. 2.	2.3847	4.1500	7.8238
1962. 3.	2.4550	4.1100	22.860
1962. 4.	2.6659	3.9700	8.9771
1962. 5.	2.6960	3.9200	-.29077
1962. 6.	2.3044	3.9300	-10.491
1962. 7.	2.9070	4.0100	-6.4700
1962. 8.	2.6559	4.0600	5.9481
1962. 9.	2.6458	4.0300	5.9279
1962.10.	2.6659	4.0000	4.3634
1962.11.	2.5153	3.9800	-.49928E-01
1962.12.	2.5052	3.9900	10.572
1963. 1.	2.9472	3.9300	-5.0756
1963. 2.	2.8769	3.9700	-1.9362
1963. 3.	2.8166	3.9900	-3.3705
1963. 4.	2.7764	4.0200	-.27079
1963. 5.	2.8568	4.0300	-1.8561
1963. 6.	2.8266	4.0500	1.2234
1963. 7.	2.9472	4.0500	5.6465
1963. 8.	3.0779	4.0200	-2.0869
1963. 9.	3.1482	4.0400	-8.1961
1963.10.	3.4197	4.1000	-6.8926
1963.11.	3.3594	4.1500	.79077
1963.12.	3.0075	4.1500	-1.8867
1964. 1.	3.4901	4.1700	2.1947
1964. 2.	3.4499	4.1600	.71027
1964. 3.	3.5304	4.1600	-11.487
1964. 4.	3.4901	4.2400	5.2936
1964. 5.	3.3091	4.2100	6.9595
1964. 6.	3.2588	4.1700	5.4550
1964. 7.	3.4398	4.1400	-5.3583
1964. 8.	3.3091	4.1800	.87108
1964. 9.	3.3091	4.1800	.87108
1964.10.	3.5102	4.1800	3.6992
1964.11.	3.4700	4.1600	-2.3391
1964.12.	3.6108	4.1800	-.94530
1965. 1.	3.4097	4.1900	2.2949
1965. 2.	3.7718	4.1800	-1.1063
1965. 3.	3.8322	4.1900	3.3870
1965. 4.	3.8121	4.1700	-1.1566
1965. 5.	3.8624	4.1800	.31778
1965. 6.	3.8121	4.1800	.36810
1965. 7.	3.8121	4.1800	-1.1465
1965. 8.	3.7618	4.1900	-8.6595
1965. 9.	3.8121	4.2500	-11.679
1965.10.	4.0134	4.3300	-2.7126
1965.11.	3.9127	4.3500	-7.1356
1965.12.	3.8121	4.4000	-13.044

1966. 1.	4.3155	4.4900	-13.457
1966. 2.	4.5169	4.5800	-30.229
1966. 3.	4.4363	4.7800	29.121
1966. 4.	4.5169	4.5900	-5.9854
1966. 5.	4.6177	4.6300	-9.0755
1966. 6.	4.5169	4.6900	-13.458
1966. 7.	4.6177	4.7300	-5.8963
1966. 8.	4.6177	4.8200	-37.663
1966. 9.	4.8193	5.0700	47.204
1966.10.	5.1218	4.7600	14.784
1966.11.	4.8193	4.6600	-19.849
1966.12.	4.3155	4.7900	36.825
1967. 1.	4.6177	4.5500	16.593
1967. 2.	4.5169	4.4400	-31.884
1967. 3.	4.5169	4.6500	21.338
1967. 4.	4.1141	4.5100	-29.897
1967. 5.	3.5102	4.7100	-16.976
1967. 6.	3.4097	4.8300	-39.474
1967. 7.	3.7114	5.1000	18.050
1967. 8.	3.8121	4.9900	-18.512
1967. 9.	4.2651	5.1200	-8.2329
1967.10.	4.3155	5.1300	-41.545
1967.11.	4.2148	5.4600	-19.859
1967.12.	4.5169	5.6000	5.6269
1968. 1.	4.5169	5.5700	31.345
1968. 2.	4.8193	5.3700	-2.4787
1968. 3.	4.7185	5.3900	-29.621
1968. 4.	5.0209	5.5900	18.744
1968. 5.	5.5253	5.4700	-.55353E-01
1968. 6.	5.5253	5.4700	24.179
1968. 7.	5.3235	5.3100	28.764
1968. 8.	5.3235	5.1200	-12.320
1968. 9.	5.0209	5.2000	-13.452
1968.10.	5.2226	5.2900	-16.593
1968.11.	5.2731	5.4000	-22.592
1968.12.	5.1218	5.5500	-55.612
1969. 1.	6.3332	5.9200	-12.530
1969. 2.	6.0302	6.0000	-12.147
1969. 3.	5.9292	6.0800	-18.025
1969. 4.	5.4244	6.2000	43.185
1969. 5.	6.4343	5.9200	-56.555
1969. 6.	5.9292	6.2900	18.536
1969. 7.	6.2322	6.1700	-.62033E-01
1969. 8.	6.7376	6.1700	-6.6260
1969. 9.	7.1423	6.2100	-75.148
1969.10.	7.2435	6.7000	26.719
1969.11.	6.8388	6.5200	-42.723
1969.12.	7.0411	6.8000	-1.7557
1970. 1.	7.5472	6.8100	-5.2811
1970. 2.	7.7497	6.8400	64.219
1970. 3.	6.6365	6.4100	-10.829
1970. 4.	6.7376	6.4800	-63.871
1970. 5.	6.7376	6.9000	-78.597
1970. 6.	6.5354	7.4200	41.779
1970. 7.	6.1312	7.1500	61.603
1970. 8.	6.2827	6.7500	-22.252
1970. 9.	6.3332	6.9000	24.801
1970.10.	6.0302	6.7400	-8.3778
1970.11.	5.4244	6.8000	89.223
1970.12.	4.8193	6.2200	-10.716

1971. 1.	4.7185	6.3000	51.564
1971. 2.	4.2148	5.9700	-19.449
1971. 3.	3.3594	6.1100	60.306
1971. 4.	3.5102	5.7300	-35.645
1971. 5.	3.9127	5.9800	-20.652
1971. 6.	4.3155	6.1300	-23.934
1971. 7.	5.0209	6.3000	1.2789
1971. 8.	5.2226	6.3000	55.604
1971. 9.	4.6177	5.9400	22.527
1971.10.	4.6177	5.8000	8.7556
1971.11.	4.1644	5.7500	-4.4730
1971.12.	4.0134	5.7900	-1.2526
1972. 1.	3.5102	5.8100	-11.332
1972. 2.	3.2086	5.9000	10.264
1972. 3.	3.2588	5.8500	-17.099
1972. 4.	3.6108	5.9800	2.3691
1972. 5.	3.4097	5.9800	28.319
1972. 6.	3.6108	5.8100	-5.3738
1972. 7.	3.7114	5.8600	21.839
1972. 8.	3.6108	5.7300	6.6631
1972. 9.	4.5169	5.7000	-21.536
1972.10.	4.5673	5.8500	19.458
1972.11.	4.5169	5.7300	22.418
1972.12.	4.9201	5.5900	-35.681
1973. 1.	4.9201	5.8300	-153.58
1973. 2.	5.2731	6.8500	-2.9669
1973. 3.	5.7272	6.8800	5.6966
1973. 4.	6.1312	6.8500	-3.8250
1973. 5.	6.0807	6.8800	-21.920
1973. 6.	6.7376	7.0300	-8.7952
1973. 7.	7.5472	7.0900	-73.158
1973. 8.	8.3578	7.5700	38.592
1973. 9.	8.6621	7.3100	42.572
1973.10.	7.2435	7.0200	-38.089
1973.11.	7.2941	7.2700	24.210
1973.12.	7.2435	7.1100	-28.911
1974. 1.	7.3447	7.3000	-12.162
1974. 2.	7.2435	7.3800	-16.524
1974. 3.	7.5472	7.4900	-47.010
1974. 4.	8.3578	7.8000	-49.025
1974. 5.	8.8650	8.1200	8.3428
1974. 6.	7.6484	8.0600	.41162
1974. 7.	7.8510	8.0600	-39.171
1974. 8.	8.3071	8.3200	-28.765
1974. 9.	9.5758	8.5100	17.109
1974.10.	7.0411	8.3900	60.419
1974.11.	7.0411	8.0000	38.824
1974.12.	7.2941	7.7500	15.602
1975. 1.	7.0411	7.6500	2.1235
1975. 2.	5.4244	7.6400	8.2741
1975. 3.	4.6177	7.6000	-59.117
1975. 4.	5.3134	8.0100	-48.800
1975. 5.	5.0209	8.3500	30.592
1975. 6.	4.9705	8.1700	33.492
1975. 7.	5.6263	7.9700	-15.832
1975. 8.	6.0807	8.0900	-38.885
1975. 9.	5.9292	8.3600	-15.745
1975.10.	6.2322	8.4800	71.920
1975.11.	5.2226	8.0200	-12.349
1975.12.	5.0209	8.1200	47.023

1976. 1.	5.0209	7.8300	-.22014
1976. 2.	4.4162	7.8500	11.007
1976. 3.	4.7689	7.8000	-12.115
1976. 4.	4.7689	7.9000	-4.4420
1976. 5.	4.7689	7.9500	-22.567
1976. 6.	5.3235	8.1200	24.001
1976. 7.	5.2731	7.9800	-1.8370
1976. 8.	5.0209	8.0100	27.223
1976. 9.	5.0209	7.8500	13.431
1976.10.	5.0713	7.7800	10.282
1976.11.	4.7185	7.7300	40.877
1976.12.	4.3658	7.4800	51.582
1977. 1.	4.1644	7.1600	-75.764
1977. 2.	4.5673	7.6800	-5.9750
1977. 3.	4.4766	7.7400	10.837
1977. 4.	4.5572	7.6900	4.6471
1977. 5.	4.4162	7.6800	7.8077
1977. 6.	4.7689	7.6500	25.600
1977. 7.	4.9705	7.5000	-15.646
1977. 8.	5.2731	7.6200	19.008
1977. 9.	5.3235	7.5100	-12.959
1977.10.	5.8787	7.6100	-27.046
1977.11.	6.0807	7.8000	9.2924
1977.12.	5.5758	7.7500	-28.118
1978. 1.	5.7777	7.9500	-19.032
1978. 2.	5.9796	8.0900	-8.4921
1978. 3.	6.0807	8.1600	-16.096
1978. 4.	6.4343	8.2800	-2.6982
1978. 5.	6.1817	8.3100	-22.105
1978. 6.	6.4343	8.4700	-22.198
1978. 7.	6.5354	8.6300	12.697
1978. 8.	6.5354	8.5600	29.288
1978. 9.	7.6484	8.3800	-28.046
1978.10.	7.8510	8.5700	-43.205
1978.11.	8.8650	8.8600	19.685
1978.12.	8.8143	8.7300	-34.920
1979. 1.	8.8650	8.9600	18.270
1979. 2.	9.4742	8.8400	-38.499
1979. 3.	9.3726	9.0900	11.834
1979. 4.	9.6266	9.0100	-30.909
1979. 5.	9.4742	9.2100	23.970
1979. 6.	9.6774	9.0500	40.267
1979. 7.	8.7635	8.7800	-19.674
1979. 8.	9.0173	8.9100	-22.827
1979. 9.	10.033	9.0600	-35.809
1979.10.	10.186	9.2900	-190.22
1979.11.	11.611	10.540	68.601
1979.12.	10.237	10.080	-3.1858
1980. 1.	10.084	10.100	-152.96
1980. 2.	11.509	11.110	-176.09
1980. 3.	13.142	12.270	-20.562
1980. 4.	15.241	12.400	237.98
1980. 5.	9.8299	10.810	76.711
1980. 6.	7.5472	10.310	48.201
1980. 7.	6.1817	10.010	-97.651
1980. 8.	7.2941	10.680	-95.064
1980. 9.	9.0680	11.330	-73.469
1980.10.	10.745	11.830	-70.102
1980.11.	11.306	12.300	.99453
1980.12.	15.190	12.300	48.607

1981. 1.	11.102	11.960	-65.785
1981. 2.	13.909	12.400	-115.11
1981. 3.	14.370	13.150	38.160
1981. 4.	13.449	12.890	-150.51
1981. 5.	13.347	13.880	118.67
1981. 6.	16.062	13.100	-84.751
1981. 7.	14.677	13.640	-94.943
1981. 8.	14.831	14.260	-130.83
1981. 9.	15.190	15.120	-69.742
1981.10.	13.909	15.580	136.47
1981.11.	12.632	14.690	170.18
1981.12.	10.298	13.580	-67.905
1982. 1.	9.5758	14.050	-13.701
1982. 2.	12.019	14.170	20.326
1982. 3.	12.121	14.050	30.707
1982. 4.	13.347	13.860	47.466
1982. 5.	12.376	13.550	-10.943
1982. 6.	11.407	13.630	-62.906
1982. 7.	11.611	14.060	70.606
1982. 8.	8.7635	13.610	165.40
1982. 9.	6.5354	12.550	152.93
1982.10.	6.9399	11.580	130.35
1982.11.	7.8004	10.750	-31.887
1982.12.	7.5978	10.980	53.364